

STORMWATER REPORT EXECUTIVE SUMMARY

The Arsenal On The Charles West Garage, Building 2, and Site Improvements



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August 9, 2016

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FIGURES

FIG. 1 – USGS Locus Map

FIG. 2 – Existing Conditions Hydrology Plan

FIG. 3 – Proposed Conditions Hydrology Plan

FIG. 4 – Activity & Use Limitations

1.0 Site Narrative

1.1 SITE OVERVIEW

The West Garage, Building 2, and Site Improvements Project (hereinafter referred to as the Project) involves the construction of a seven-tier parking facility, a three-story commercial building, and associated site work at the Arsenal on the Charles campus (hereinafter referred to as the Campus) located in Watertown, Massachusetts (See FIG. 1). The Site, approximately 5.6 acres of the 29.5-acre Campus, generally consists of the following portions of the existing Campus:

- Parking areas west of Buildings 311 and 29
- The southern half of Building 39
- The parking area south of Building 39
- A portion of School Street between Building 311 and North Beacon Street
- Wooley Avenue from Arsenal Street to School Street

The Campus, currently owned by **Athena Arsenal, LLC**, is a portion of the former Watertown Arsenal, first established in 1816 by the United States Army. Prior to being converted to commercial use, the Campus served several military uses, including ordnance storage, materials research, and manufacturing. The Project, as part of the Arsenal Overlay Development District Campus Plan, will meet the needs of an expanding workforce and create a welcoming environment for the surrounding community.

In addition to the proposed West Garage and Building 2 construction, key features of the Project include vehicular and pedestrian circulation improvements, new open space for active community engagement, various site enhancements, and a new comprehensive stormwater management system. The stormwater management component the Project includes an entirely new drainage network to convey, treat, and detain stormwater runoff. This report documents how the Project will reduce the peak rate of stormwater discharging from the Site in addition to improving water quality. The goals and objectives will be achieved through the implementation of Best Management Practices (BMPs) and Low Impact Design (LID) techniques which will include:

- Permeable pavers
- Partial green roof for Building 2
- Rainwater cisterns
- Water quality structures

- Stormwater detention swales
- Subsurface detention systems

This report was developed in accordance with both the Town of Watertown's (hereinafter referred to as the Town) "Rules and Regulations for Stormwater Management" document adopted by the Town Council on February 23, 2016 and the Massachusetts Department of Environmental Protection's (MADEP) "Stormwater Management Standards" (hereinafter referred to as the MA Stormwater Handbook). Documentation of compliance with the applicable rules, regulations, and standards associated with the Town's Rules and Regulations and MADEP's Stormwater Management Standards can be found in Sections 2 and 3, respectively, of this report.

1.2 SITE WATERSHED

The Site is located within the Charles River Watershed. All stormwater runoff from the Site is conveyed to the Town's municipal drainage system before discharging to the Lower Charles River Basin. A Total Maximum Daily Load (TMDL) for both phosphorus and pathogens has been established for this basin.

The Site's existing stormwater management plan includes few BMPs or LID techniques to treat runoff prior to discharge. The proposed stormwater management system involves a new conveyance system and a multi-faceted approach to stormwater management that includes multiple BMPs and LID techniques to significantly reduce the flow rate of stormwater leaving the Site. This stormwater management system will significantly improve the water quality of stormwater discharging from the Site and address pathogens, phosphorus, and Total Suspended Solids (TSS) loading to the Charles River.

The Site is not located within the regulated 200' Riverfront Area of the Charles River, buffer zone associated with wetland resource areas, or a flood plain.

1.3 SITE TOPOGRAPHY

All elevations (El.) reference the North American Vertical Datum of 1988 (NAVD88) unless otherwise noted. The Site's existing topography slopes north to south from El. 35' (high) along Arsenal Street to El. 22' (low) along North Beacon Street. Three existing detention swales run parallel to the Site's southern property line. These detention swales vary in length and are approximately one foot in depth.

1.4 SITE GROUNDWATER ELEVATIONS

Based on available monitoring well data collected by Weston & Sampson (1996), and Sanborn, Head & Associates, Inc. (2016), groundwater for the Site flows north to south towards the Charles River following Site topography. Depth to groundwater ranges from approximately 7.5 to 13.5 feet below existing grade within the vicinity of the proposed West Garage and Building 2. This corresponds to groundwater elevations ranging from El. 17' to El. 23'. Depth to groundwater ranges from approximately 6.2 to 8.5 feet below

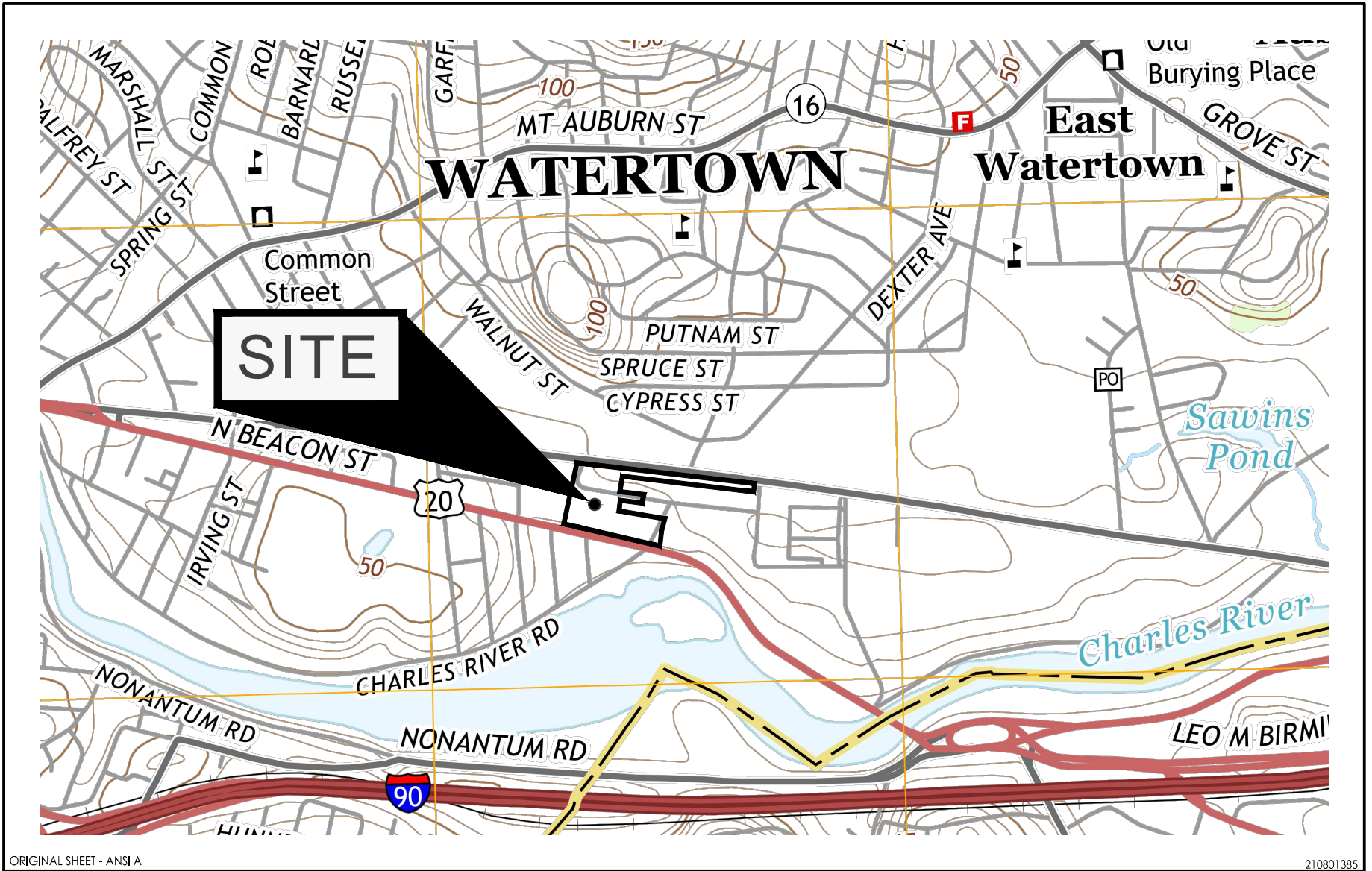
existing grade at the locations of proposed subsurface detention systems. This corresponds to groundwater elevations ranging from El. 16' to El. 25.3'.

A Groundwater Contour Map prepared by Weston and Sampson in 1996, and a Water Level Measurement Form documenting groundwater elevations observed in April 2016 in sixteen wells on site, are included for reference in Appendix B of the full Stormwater Report.

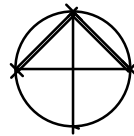
1.5 SITE ENVIRONMENTAL REVIEW

The Site, first developed by the United States Army in the early 1800's, was utilized by the Army until 1995. During that span, the Site, including current and former buildings, provided various uses, including ordnance storage, materials research, and manufacturing. The Site was redeveloped in the late 1990's into a mixture of office and light manufacturing. Several Activity Use Limitation (AULs) and Grants of Environmental Restrictions and Easements exist for the Site. The AULs and Grants include a variety of special conditions for the Site, including limitations of future uses for designated areas and excavation limitations. No portion of the proposed stormwater network falls within the limits of any existing AUL or Grant of Environmental Restriction and Easement.

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Client/Project

Athena Arsenal, LLC.

THE ARSENAL ON THE CHARLES
WEST GARAGE, BUILDING 2, AND SITE IMPROVEMENTS

Figure No.

1.0

Title

USGS LOCUS MAP

2.0 Massachusetts Stormwater Handbook Standards

2.1 STANDARD 1 – NO UNTREATED DISCHARGES OR EROSION TO WETLANDS

Stormwater Management Standard 1 requires that all new stormwater conveyances (e.g. outfalls) do not discharge untreated or cause erosion in wetlands or waters of the Commonwealth.

All stormwater will be captured and treated on-site. After treatment and detention where practicable, all discharge from the Site's stormwater management system will overflow to the Town's stormwater network in North Beacon Street. No untreated stormwater will discharge from the Site. Therefore, Standard 1 is met.

2.2 STANDARD 2 – PEAK RATE ATTENUATION

Stormwater Management Standard 2 requires that post-development peak discharge rates do not exceed pre-development peak discharge rates.

The Project is one part of a phased project on a previously developed site that will result in no net increase in impervious area. The Project will reduce impervious area by 2%. Therefore, the Site is considered a redevelopment project in accordance with the MA Stormwater Handbook. As a redevelopment project, the Site must meet Standard 2 to the maximum extent practicable.

Utilizing HydroCAD software, a hydrologic model was developed to generate peak runoff rates for both the existing and proposed conditions of the site. This stormwater runoff model indicates that the post-development peak discharge rates will not exceed the pre-development peak discharge rates for the 2-year, 10-year, 25-year, or 100-year storms. The methodology and design criteria for the model can be found below.

2.2.1 Methodology and Design Criteria

Hydrologic Model Description

Drainage analysis was performed using the Soil Conservation Service (SCS) TR-55 and TR-20 methodologies as facilitated by the computer program HydroCAD 10.00 by HydroCAD Software Solutions, LLC.

Soil Conditions

The Natural Resources Conservation Service (NRCS) Soil survey of Middlesex County, Massachusetts defines the soils on the Site as urban land (map symbol 605). This soil classification is not part of a specific hydrologic soil group (HSG). Therefore, HSG classifications of the Site's soils rely on available studies that have been conducted for the Project.

The Campus underwent several series of groundwater monitoring programs throughout the early to mid-1990's. Geotechnical data from these programs indicate that the Site is composed of a fill layer overlaying various sand layers.

In September 2015, Haley & Aldrich, Inc. completed a subsurface investigation of the Site. This investigation indicated that the immediate subsurface material consists of both fill (loose to medium dense sand and gravel) and glaciofluvial deposits (lose to very dense sand).

In April 2016, Sanborn, Head, & Associates, Inc. conducted a total of 12 test pits and 33 soil borings across the Campus. Monitoring wells were installed in 12 of the soil borings during this program. Copies of the test pit logs and soil boring/monitoring well logs are included in Appendix B of the full Stormwater Report for reference.

The April 2016 test pits and soil borings show that soils on-site generally consist of fill material overlaying sand or sand and gravel deposits. The fill layers are classified as sand or loamy sand. Based on the available data for the Site, a "HSG A" classification has been utilized for the Site and was applied to all hydrologic models and calculations.

Time of Concentration

The Time of Concentration (T_c) for each watershed was determined by finding the time necessary for runoff to travel from the most hydraulically distant point in the watershed to the point of concentration. The travel path was drawn based on the topography and the time was calculated using the TR-55 Method and HydroCAD. The minimum T_c value of 5.0 minutes was selected as the most conservative value for the Site.

Curve Numbers

Curve numbers were developed for each subcatchment drainage area based on the different use categories and hydrologic soil group types. Based on the soil conditions outlined above, a hydrologic soil group classification of "HSG A" was utilized for hydrologic models and calculations. The curve numbers were based on the SCS TR-55 methodology and can be found in the attached HydroCAD report.

Design Storms

The stormwater model was analyzed for performance during 2-, 10-, 25-, and 100-year frequency rainfall events. The events were based on the 24-hour, Type-III duration storm. Rainfall depths corresponding to the selected rain events can be found in Table 2.1 and were acquired from Cornell University's "Extreme Precipitation in New York & New England" database.

Table 2.1 – Design Storm Events

Storm Event	Rainfall Depth (in.)
2-Year	3.2
10-Year	4.9
25-Year	6.2
100-Year	8.9

Design Point

Stormwater runoff for the Site currently discharges to the Town's stormwater network within North Beacon Street south of the Site's southern property line. This location has been identified as the sole Design Point and is identified as DP-1 for the Project. See both FIG. 2 and FIG. 3 for the location of DP-1.

2.2.2 Existing Drainage Areas

The following assumptions were made for the purpose of this hydrologic analysis:

- Whenever possible, the property line, and/or a line outside the limit of proposed work, was delineated as the watershed boundary.
- The total watershed area for the proposed conditions corresponds to the total watershed area for the existing conditions.

For the existing conditions analysis, the Site was divided into seven subcatchment areas (See FIG. 2). The peak discharge rate for the pre-development conditions was analyzed at DP-1. A general description of each subcatchment is described below.

Subcatchment EX1

Subcatchment EX1 is composed of the northern parking area, the majority of the southern parking area, and Wooley Avenue from the intersection of Arsenal Street until approximately 170 ft. east of the western face of Building 311. The majority of this subcatchment consists of paved, impervious areas with several small areas of green space and impervious sidewalks. Stormwater runoff from this subcatchment is captured by existing catch basins, conveyed through the Site's existing drainage network, and discharged to the Town's storm drain line within North Beacon Street. Runoff conveyed by this municipal storm drain line eventually discharges to the Charles River through Drainage Outfall #18, as shown on the *Watertown Stormwater System Map* published by the Watertown Department of Public Works.

Subcatchment EX2

Subcatchment EX2 is composed of the southern-most portion of the existing southern parking lot and existing stormwater detention swale P1X1. This subcatchment consists of paved, impervious areas, a lightly wooded area surrounding P1X1, several small areas of green space, and impervious sidewalks.

Stormwater runoff from this subcatchment flows southerly to P1X1. Overflow from P1X1 is transferred to the Site's existing drainage system and discharged to the Town's storm drain line within North Beacon Street. Runoff conveyed by this municipal storm drain line eventually discharges to the Charles River through Drainage Outfall #18, as shown on the *Watertown Stormwater System Map* published by the Watertown Department of Public Works.

Subcatchment EX3

Subcatchment EX3 is composed of the roof area of Building 39. Stormwater runoff from this subcatchment is captured by the building's roof drainage system, conveyed through the Site's existing drainage network, and discharged to the Town's storm drain line within North Beacon Street. Runoff conveyed by this municipal storm drain line eventually discharges to the Charles River through Drainage Outfall #18, as shown on the *Watertown Stormwater System Map* published by the Watertown Department of Public Works.

Subcatchment EX4

Subcatchment EX4 is composed of the majority of the parking area south of Building 39, the parking area east of Building 39, and existing stormwater detention swale P1X2. This subcatchment consists of paved, impervious areas, a lightly wooded area surrounding P1X2, several small areas of green space, and impervious sidewalks. Stormwater runoff from this subcatchment flows southerly to P1X2. Overflow from P1X2 overtops the detention swale, is captured by municipal catch basins, and conveyed to the Town's storm drain line within North Beacon Street. Runoff conveyed by this municipal storm drain line eventually discharges to the Charles River through Drainage Outfall #18, as shown on the *Watertown Stormwater System Map* published by the Watertown Department of Public Works.

Subcatchment EX5

Subcatchment EX5 is composed of the truck bay located along the southern half of the eastern face of Building 39. This subcatchment consists entirely of impervious area. All stormwater runoff from this subcatchment is captured by an existing trench drain and conveyed to a 24" municipal storm drain line within School Street. This municipal storm drain line is located within the Site, but is part of the Town's stormwater conveyance system. Runoff conveyed by this municipal storm drain line eventually discharges to the Charles River through Drainage Outfall #18, as shown on the *Watertown Stormwater System Map* published by the Watertown Department of Public Works.

Subcatchment EX6

Subcatchment EX6 is composed of a small portion of the parking area south of Building 39 and existing stormwater detention swale P1X3. This subcatchment

consists of paved, impervious areas and a lightly wooded area surrounding P1X3. Stormwater runoff from this subcatchment flows southerly to P1X3. Overflow from P1X3 overtops the detention swale, is captured by municipal catch basins, and conveyed to the Town's storm drain line within North Beacon Street. Runoff conveyed by this municipal storm drain line eventually discharges to the Charles River through Drainage Outfall #18, as shown on the *Watertown Stormwater System Map* published by the Watertown Department of Public Works.

Subcatchment EX7

Subcatchment EX7 is composed of School Street between Wooley Avenue and North Beacon Street. This subcatchment consists entirely of paved roadway. The majority of stormwater runoff from this subcatchment is captured by existing catch basins and conveyed to a 24" municipal storm drain line within School Street. A portion of stormwater sheet flows directly into North Beacon Street. Runoff conveyed by the municipal storm drain line eventually discharges to the Charles River through Drainage Outfall #18, as shown on the *Watertown Stormwater System Map* published by the Watertown Department of Public Works.

2.2.3 Existing Drainage Summary

A summary of the existing drainage areas can be found in *Table 2.2*:

Table 2.2 – Existing Drainage Summary

Drainage Area	Area (sf)	Curve Number
EX1	125,682	89
EX2	25,275	78
EX3	18,818	98
EX4	36,526	82
EX5	4,715	98
EX6	6,225	66
EX7	17,865	97
TOTAL	235,106	88

2.2.4 Proposed Drainage Areas

The following assumptions were made for the purpose of this hydrologic analysis:

- Whenever possible, the property line, and/or an arbitrary line outside the limit of proposed work, was delineated as the watershed boundary.
- The total watershed area for the proposed conditions is based solely on the total watershed area for the existing conditions.

- There is no modification in the proposed conditions as to the location of the Design Point identified in the existing conditions.

For the proposed conditions analysis, the Site was divided into twelve subcatchments (See FIG. 3). The peak discharge rate for the post-development conditions was analyzed at DP-1. A general description of each subcatchment is described below.

Subcatchment PR1A1

Subcatchment PR1A1 is composed of the area between the northern face of proposed Building 2 and the northern property line and the northwestern entrance to the proposed West Garage. This subcatchment consists of impervious paved area, unit pavers, permeable pavers, green space, and planting beds. Stormwater runoff from this subcatchment is captured, routed through water quality units/inlets, and discharged to subsurface detention system P1A. Runoff is released from P1A through an outlet control structure and is, eventually, discharged to DP-1.

Subcatchment PR1A2

Subcatchment PR1A2 is composed of the roof area of proposed Building 2. This subcatchment consists of partial green roof area in addition to standard roof area. Stormwater runoff from this subcatchment is captured by the building's roof drainage system, routed through a water quality unit, and discharged to subsurface detention system P1A. Runoff is released from P1A through an outlet control structure and is, eventually, discharged to DP-1.

Subcatchment PR1B1

Subcatchment PR1B1 is composed of the area between the western face of proposed West Garage and the western property line. This subcatchment consists of impervious paved area and green space. Stormwater runoff from this subcatchment is captured, routed through a water quality unit, and discharged to subsurface detention system P1B. Runoff is released from P1B through an outlet control structure and is, eventually, discharged to DP-1.

Subcatchment PR1B2

Subcatchment PR1B2 is composed of approximately one-half of the roof deck of the proposed West Garage. Stormwater runoff from this subcatchment is captured by the structure's roof drainage system, routed through multiple water quality units, and discharged to subsurface detention system P1B. Runoff is released from P1B through an outlet control structure and is, eventually, discharged to DP-1.

Subcatchment PR1C1

Subcatchment PR1C1 is composed of approximately one-half of the roof deck of the proposed West Garage. Stormwater runoff from this subcatchment is captured by the structure's roof drainage system, routed through a water quality unit, and discharged to two proposed rainwater cisterns. Cistern overflow is conveyed to

subsurface detention system P1C. Runoff is released from P1C through an outlet control structure and is, eventually, discharged to DP-1.

Subcatchment PR1C2

Subcatchment PR1C2 is composed the area between the eastern face of the proposed West Garage and the western faces of Building 311 and Building 39; a portion of Wooley Avenue running from the western face of Building 311 to approximately 170 ft. from the western face of Building 311; the southeast entrance driveway of the proposed West Garage; approximately one-half of the parking area south of Building 39; and several areas of green space. This subcatchment consists of impervious paved areas, unit pavers, permeable pavers, green space, and impervious sidewalks. Stormwater runoff from this subcatchment is captured, routed through a water quality unit, and discharged to subsurface detention system P1C. Runoff is released from P1C through an outlet control structure and is, eventually, discharged to DP-1.

Subcatchment PR1C3

Subcatchment PR1C3 is composed of the roof area of existing Building 39. Stormwater runoff from this subcatchment is captured by the building's roof drainage system and discharged to subsurface detention system P1C. Runoff is released from P1C through an outlet control structure, routed through a water quality unit, and, eventually, discharged to DP-1.

Subcatchment PR1C4

Subcatchment PR1C4 is composed of the pocket park area south of the proposed West Garage and existing stormwater detention swale P1X1. This subcatchment consists of planting areas, chip and seal walkways, and a lightly wooded area surrounding P1X1. Stormwater runoff from this subcatchment flows southerly to P1X1. Overflow from P1X1 is transferred to the Site's proposed stormwater network, routed through a water quality unit, and discharged to subsurface detention system P1C. Runoff is released from P1C through an outlet control structure and is, eventually, discharged to DP-1.

Subcatchment PR1C5

Subcatchment PR1C5 is composed of existing stormwater detention swale P1X2. This subcatchment consists of a lightly wooded area surrounding P1X1. Stormwater runoff from this subcatchment flows southerly to P1X2. Overflow from P1X2 is discharged to subsurface detention system P1C. Runoff is released from P1C through an outlet control structure, routed through a water quality unit, and, eventually, discharged to DP-1.

Subcatchment PR1E1

Subcatchment PR1E1 is composed of the School Street, a parking area along the northern half of the western face of Building 39, approximately one-half of the

parking area south of Building 39, several areas of green space, and impervious sidewalks. Stormwater runoff from this subcatchment is captured, routed through water quality units/inlets, and discharged to subsurface detention system P1E. Runoff is released from P1E through an outlet control structure and is, eventually, discharged to DP-1.

Subcatchment PR1E2

Subcatchment PR1E2 is composed existing stormwater detention swale P1X3. This subcatchment consists of a lightly wooded area surrounding P1X1 and open green space. Stormwater runoff from this subcatchment flows southerly to P1X3. Overflow from P1X3 is discharged to subsurface detention system P1E. Runoff is released from P1E through an outlet control structure, routed through a water quality unit, and, eventually, discharged to DP-1.

Subcatchment PR1X1

Subcatchment PR1X1 is composed of the truck bay located along the southern half of the eastern face of Building 39. This subcatchment consists entirely of impervious area. All stormwater runoff from this subcatchment is captured by an existing trench drain and conveyed to a 24" municipal storm drain line within School Street. This municipal storm drain line is located within the Site, but is part of the Town's stormwater conveyance system. Runoff conveyed by this municipal storm drain line eventually discharges to the Charles River through Drainage Outfall #18, as shown on the *Watertown Stormwater System Map* published by the Watertown Department of Public Works.

2.2.5 Proposed Drainage Area Summary

A summary of the proposed drainage area can be found in *Table 2.3*:

Table 2.3 – Proposed Drainage Summary

Drainage Area	Area (sf)	Curve Number
PR1A1	8,297	91
PR1A2	12,472	91
PR1B1	9,810	76
PR1B2	36,168	98
PR1C1	35,412	98
PR1C2	33,842	88
PR1C3	18,818	98
PR1C4	23,062	55
PR1C5	5,089	43
PR1E1	42,975	86
PR1E2	4,446	42
PR1X1	4,715	97
TOTAL	235,106	86

2.2.6 Peak Discharge Runoff Rates Summary

The peak flows were calculated for the 2-, 10-, 25-, and 100-year storm events for both proposed and existing conditions to confirm that proposed peak runoff rates do not exceed existing at DP-1. The results of this calculation can be found in *Table 2.4*.

Table 2.4 – Peak Runoff Rates

Design Point		2-Year Storm (3.2")	10-Year Storm (4.9")	25-Year Storm (6.2")	100-Year Storm (8.9")
DP-1	Existing Rate (cfs)	12.51	21.91	29.12	44.29
	Proposed Rate (cfs)	2.41	3.39	5.60	35.05

A summary of the percent reduction of peak runoff rate for the 2-, 10-, 25-, and 100-year storms can be found in *Table 2.5*.

Table 2.5 – Percent Reduction of Peak Runoff from Existing Conditions

Design Point	2-Year Storm (3.2")	10-Year Storm (4.9")	25-Year Storm (6.2")	100-Year Storm (8.9")
DP-1	81%	85%	81%	21%

2.3 STANDARD 3 – STORMWATER RECHARGE

Stormwater Management Standard 3 requires that:

- The annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type;
- Infiltration structures must be able to drain fully within 72 hours; and
- There must be at least a two-foot separation between the bottom of the infiltration structure and the seasonal high groundwater.

The Project is one part of a phased project on a previously developed site that will result in no net increase in impervious area. The Project will reduce impervious area by 2%. Therefore, the Site is considered a redevelopment project in accordance with the MA Stormwater Handbook. As a redevelopment project, the Site must meet Standard 3 to the maximum extent practicable.

Several conditions exist that preclude stormwater recharge at the Site. These conditions include:

- Groundwater: Based on available monitoring well data collected by Weston & Sampson (1996), and Sanborn, Head & Associates, Inc. (2016), groundwater for the Site flows north to south towards the Charles River following Site topography. Depth to groundwater ranges from approximately 7.5 to 13.5 feet below existing grade within the vicinity of the proposed West Garage and Building 2. This corresponds to groundwater elevations ranging from El. 17' to El. 23'. Depth to groundwater ranges from approximately 6.2 to 8.5 feet below existing grade at the locations of proposed subsurface detention systems. This corresponds to groundwater elevations ranging from El. 16' to El. 25.3'. Due to high seasonal groundwater levels at the locations of the proposed subsurface detention systems, stormwater recharge through subsurface infiltration systems is not practicable for the Project.

A Groundwater Contour Map prepared by Weston and Sampson in 1996 and the Geotechnical Engineering Report prepared by Sanborn, Head & Associates, Inc. dated July 27, 2016 document observed groundwater elevations and are included for reference in Appendix B of the full Stormwater Report.

- Environmental Considerations: Due to the Site's former uses, portions of the Site have use limitations or are otherwise limited due to environmental considerations (See FIG. 4). Several AULs and Grants of Environmental Restrictions and Easements exist on the Site that restrict or otherwise limit using portions of the Site for stormwater treatment. Stormwater BMPs have been sited to avoid conflict with these existing areas of known contamination.

In the event that adjustments to the location or design of the subsurface facilities are required as part of on-going regulatory review, plans and calculations will be adjusted and provided to the Town of Watertown's DPW for review.

- Underground Utilities: The Site is currently served by underground utilities including gas, underground electrical and communications, water, sanitary sewer, and storm drainage. Some of the Site's existing utilities will remain as they currently exist, while the majority of the Site's utilities are proposed to be reconstructed or otherwise rehabilitated. Components of the stormwater system have been sited to avoid conflict with critical utility infrastructure, both existing that will remain or new that will serve the proposed structures.

As noted, the Project is one phase of the Arsenal Overlay Development District Campus Plan, a master plan detailing the proposed redevelopment of the entire 29.5-acre Campus. As documented in the Stormwater Report submitted with the Arsenal Overlay Development District Campus Plan, the Campus will meet and exceed the required recharge volume for Standard 3, despite the inability to recharge stormwater for this project phase.

2.4 STANDARD 4 – WATER QUALITY

Stormwater Management Standard 4 requires that stormwater management systems be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This standard is met when:

- Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;
- Structural stormwater best management practices are sized to capture the required water quality volume as determined in accordance with the MA Stormwater Handbook; and
- Pretreatment is provided in accordance with the MA Stormwater Handbook.

The Site meets each of the above listed requirements. Therefore, Standard 4 is met.

2.4.1 TSS Removal

Stormwater will be treated through a series of BMPs that will reduce TSS loading. Each specific series of treatments are referred to as a treatment train. Stormwater runoff from the Site will be treated for at least 80% TSS removal prior to discharge to the Town's drainage system. All runoff from impervious areas will be directed to water quality structures prior to discharging from the Site. Water quality structures are sized to treat a minimum of 80% TSS removal prior to discharging to these systems. This will prevent sediment build-up within the subsurface detention systems to maintain optimal performance.

The Treatment Trains proposed for the Site are described below:

Treatment Train #1 – Stormwater will be routed through a proprietary separator prior to discharging to a subsurface detention system. Stormwater will be routed through a second proprietary separator following detention and prior to discharging to the Town's municipal drain line:

- TSS Pre-treatment achieved prior to detention= 80%
- Total TSS removal achieved = 96%

Treatment Train #2 - Stormwater will be routed through two proprietary separators prior to discharging to a subsurface detention system. Stormwater will be discharged from a subsurface detention system to the Town's municipal drain line:

- TSS Pre-treatment achieved prior to detention= 96%
- Total TSS removal achieved = 96%

Treatment Train #3 - Stormwater will be discharged directly to a subsurface detention system. Stormwater will be routed through a proprietary separator following detention and prior to discharging to the Town's municipal drain line:

- TSS Pre-treatment achieved prior to detention= N/A
- Total TSS removal achieved = 80%

Treatment Train #4 - Stormwater will be routed through a proprietary separator prior to discharging to a subsurface detention system. Stormwater will be discharged from a subsurface detention system to the Town's municipal drain line:

- TSS Pre-treatment achieved prior to detention= 80%
- Total TSS removal achieved = 80%

The effective composite TSS removal rate from the Site is 92%. Appendix F of the full Stormwater Report contains TSS removal worksheets for each treatment train and a calculation of the composite TSS removal from the Site.

Table 2.6 – TSS Removal Treatment Train Summary

Treatment Train	Minimum Required Pre-treatment (% TSS Removal)	Provided Pre-treatment (% TSS Removal)	Minimum Required TSS Removal Rate (% TSS Removal)	Provided TSS Removal Rate (% TSS Removal)
1	N/A	80	80	96
2	N/A	96	80	96
3	N/A	N/A	80	80
4	N/A	80	80	80
TOTAL	-	-	80	92

2.4.2 Phosphorus Removal

In addition to TSS Removal, the TMDL for the Lower Charles River Basin requires the removal of phosphorus prior to discharge. Stormwater runoff will be treated to remove phosphorus prior to discharge from the Site by utilizing precast proprietary units with filter media (phosphorus removal units).

The Treatment Train proposed for phosphorus removal for the Site is described below:

Treatment Train #1 – Stormwater will be routed through a proprietary separator (phosphorus removal unit) to remove phosphorus prior to discharging to the Town's municipal drain line. The phosphorus removal unit is composed of a precast structure with high flow pre-treatment and an internal membrane filtration component.

2.4.3 Water Quality Volume

As noted in Section 2.3 of this report, stormwater recharge is not practicable for the Site. Therefore, meeting the required water quality volume of one inch times the impervious area cannot be achieved through stormwater recharge. In order to meet the required water quality volume, all stormwater runoff will be routed through water quality structures, phosphorus removal units, or a combination of both. These units are sized to treat the equivalent flow rate of one inch times the total impervious area routed through each specific unit. Calculations documenting the proposed structure and unit sizing can be found in Appendix G of the full Stormwater Report.

2.4.4 Long-Term Pollution Prevention

A long-term pollution prevention plan for the Site is included as part of the Operation and Maintenance Plan in Section 5 of the full Stormwater Report. An Operation and Maintenance Log can be found in Appendix H of the full Stormwater Report.

2.5 STANDARD 5 – LAND USES WITH HIGHER POTENTIAL POLLUTANT LOADS

Stormwater Management Standard 5 requires that, for land uses with higher potential pollutant loads (LUHPPL), source control and pollution prevention be implemented in accordance with the MA Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.

Specifically, stormwater discharges from LUHPPLs requires the use of a treatment train that provides 80% TSS removal prior to discharge. Additionally, the required water quality volume must equal one inch times the impervious area.

The parking areas (both for the proposed West Garage and surface lots) for the Site are considered a LUHPPL because, combined, they will generate greater than 1,000 vehicle trips per day. The proposed stormwater network provides a minimum of 80% TSS removal prior to discharging through the usage of water quality structures. Additionally, the units are sized to treat the equivalent flow rate of one inch times the total impervious area routed through each specific unit. Therefore, Standard 5 is met.

2.6 STANDARD 6 – CRITICAL AREAS

Stormwater Management Standard 6 requires that stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or to any other critical area must include the use of the specific source control and pollution prevention measures. All specific structural BMPs are required to have been determined suitable for the particular critical area. Stormwater discharges from Outstanding Resource Waters requires the use of a treatment train that provides 80% TSS removal prior to discharge and at least 44% TSS removal prior to discharge to the infiltration BMP.

The Site is not considered to be within a critical area; therefore, Standard 6 is not applicable.

2.7 STANDARD 7 – REDEVELOPMENT

Stormwater Management Standard 7 states that a **redevelopment** project is required to meet the following Stormwater Management Standards, all to the maximum extent practicable:

- Standard 2 - Peak Rate Attenuation
- Standard 3 - Recharge

And the pretreatment and structural BMP requirements of:

- Standards 4 – Water Quality
- Standard 5 – Land Uses with Higher Potential Pollutant Loads
- Standard 6 – Critical Areas

A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

The Project is one part of a phased project on a previously developed site that will result in no net increase in impervious area. The Project will reduce impervious area by 2%. Therefore, the Site is considered a redevelopment project in accordance with the MA Stormwater Handbook.

Although the Site is considered a redevelopment project, the design meets the requirements of Standards 1, 2, 4, 5, 6, 8, 9 and 10, which exceeds the requirements of Standard 7.

2.8 STANDARD 8 – CONSTRUCTION PERIOD CONTROLS

Pollution prevention and erosion and sedimentation control measures will be implemented during construction. Control measures will address construction-related impacts and land disturbance activities. The Site will disturb more than one acre of land and will require a National Pollutant Discharge Elimination System (NPDES) Construction General Permit (CGP) issued by the Environmental Protection Agency (EPA). As part the CGP, a Stormwater Pollution Prevention Plan (SWPPP) will be required as well. The SWPPP will be provided prior to construction. A Site Preparation Plan has been included as part of the Site Plan Review Submission.

2.9 STANDARD 9 – OPERATION AND MAINTENANCE PLAN

Stormwater Management Standard 9 requires that a long-term operation and maintenance (O&M) plan be developed and implemented to ensure that stormwater management systems function as designed. The full long-term O&M plan is provided in Section 5 of the full Stormwater Report.

2.10 STANDARD 10 – ILLICIT DISCHARGES TO DRAINAGE SYSTEM

Stormwater Management Standard 10 prohibits illicit discharges to stormwater management systems. The MA Stormwater Handbook describes illicit discharges to the stormwater management system as discharges that are not entirely comprised of stormwater.

The Illicit Discharge Compliance Statement for the Site plan is as follows:

*Per the requirements of Standard 10 of the Massachusetts Stormwater Management Standards, **no illicit discharges exist** for the Site.*

Standard 10 also requires that, in addition to the Illicit Discharge Compliance Statement, a site map, drawn to scale, must identify the location of all systems conveying stormwater on the Site and display that no connections between these systems and any waste management system exist. Engineering drawings accompanying the Site Plan Review submission display the location of all stormwater management components, as well as other utilities (sanitary sewer and water). These drawings serve as site maps and establish that no illicit discharges are proposed for this Site.

3.0 Town of Watertown Rules and Regulations for Stormwater Management and Erosion Control

3.1 STORMWATER MANAGEMENT PLAN

3.1.1 Existing Conditions Plan

An existing conditions plan containing necessary information to describe the existing surface Site features has been included in the drawing set as part of the Site Plan Review submission.

3.1.2 Proposed Conditions Plan

Proposed conditions plans containing necessary information to describe the proposed Site features has been included in the drawing set as part of the Site Plan Review submission.

3.1.3 Erosion and Sediment Control Plan

A Site Preparation Plan containing necessary information to demonstrate that erosion and sedimentation will be minimized has been included as part of the Site Plan Review Submission. Additional information relating to erosion and sediment control is included in Section 4 of the full Stormwater Report.

3.1.4 Construction Detail Plan

Construction detail plans containing necessary construction details related to Site construction have been included in the drawing set as part of the Site Plan Review submission.

3.1.5 Stormwater Management Report

This Stormwater Report has been prepared to document compliance with the MA *Stormwater Handbook* as well as the *Town of Watertown Rules and Regulations for Stormwater Management and Erosion Control*. Compliance with the standards described in these regulations is documented in Sections 2 and 3 of this report.

3.1.6 Operation and Maintenance Plan

An Operation and Maintenance Plan has been prepared for this Site. Refer to Section 5 of the full Stormwater Report. An Operation and Maintenance Log can be found in Appendix H of the full Stormwater Report.

3.2 PERFORMANCE STANDARDS

3.2.1 Retention Standards

Section 8.1 of the Watertown Stormwater Management and Erosion Control Ordinance states that stormwater runoff from all new development and redevelopment projects must be retained on-site to the Maximum Extent Practicable for all storms up to the 100-year, 24-hour storm event.

As outlined in Section 3.2.3 of this report, retaining all storms up to the 100-year, 24-hour storm event is not practicable for the Project. Per Section 8.6 of the Watertown Stormwater Management and Erosion Control Ordinance, the Town may permit the installation of stormwater management systems at off-site locations if the on-site stormwater runoff retention requirement is not met. As specified in the Stormwater Report submitted as part of the Arsenal Overlay Development District Campus Plan, off-site stormwater mitigation has been proposed at the Commander's Mansion parking area and at the southern end of Talcott Avenue. These mitigation locations have been reviewed and approved by the Watertown Department of Public Works. A detailed description of each off-site stormwater mitigation location can be found in Section 3.2.6 of the Arsenal Overlay Development District Campus Plan Stormwater Report.

3.2.2 Maximum Extent Practicable

This report and supporting calculations provide documentation that demonstrates the Site will retain stormwater on-site to the Maximum Extent Practicable.

- All reasonable efforts have been made to meet the intent of the applicable recharge requirements as further described in the sections below.
- Several alternate stormwater measures were considered and evaluated for this Site. Proposed stormwater BMPs and LID techniques include:
 - Permeable pavers
 - Partial green roof for Building 2
 - Rainwater cisterns
 - Stormwater detention swales
 - Subsurface detention systems
 - Water Quality Structures
- These techniques are employed where feasible and designed to be interwoven into the landscape of the Site to form a comprehensive stormwater management design.
- Stormwater mitigation and treatment BMPs have been employed to the maximum extent practicable. The stormwater management system as designed will reduce peak stormwater runoff rates as summarized in *Table 2.5* of this report.

3.2.3 Factors Affecting Retention Potential

Several factors affect the proposed stormwater network's ability to fully meet the 100-year storm recharge requirement. These factors are described in the following:

- Groundwater: Based on available monitoring well data collected by Weston & Sampson (1996), and Sanborn, Head & Associates, Inc. (2016), groundwater for the Site flows north to south towards the Charles River following Site topography. Depth to groundwater ranges from approximately 7.5 to 13.5 feet below existing grade within the vicinity of the proposed West Garage and Building 2. This corresponds to groundwater elevations ranging from El. 17' to El. 23'. Depth to groundwater ranges from approximately 6.2 to 8.5 feet below existing grade at the locations of proposed subsurface detention systems. This corresponds to groundwater elevations ranging from El. 16' to El. 25.3'. Due to high seasonal groundwater levels at the locations of the proposed subsurface detention systems, stormwater recharge through subsurface infiltration systems is not practicable for the Project.

A Groundwater Contour Map prepared by Weston and Sampson in 1996 and the Geotechnical Engineering Report prepared by Sanborn, Head & Associates, Inc. dated July 27, 2016 document observed groundwater elevations and are included for reference in Appendix B of the full Stormwater Report.

- Environmental Considerations: Due to the Site's former uses, portions of the Site have use limitations or are otherwise limited due to environmental considerations. Several AULs and Grants of Environmental Restrictions and Easements exist on the Site that restrict or otherwise limit using portions of the Site for stormwater treatment. Stormwater BMPs have been sited to avoid conflict with these existing areas of known contamination.

In the event that adjustments to the location or design of the subsurface facilities are required as part of on-going regulatory review, plans, and calculations will be adjusted and provided to the Town of Watertown's DPW for review.

- Underground Utilities: The Site is currently served by underground utilities including gas, underground electrical and communications, water, sanitary sewer, and storm drainage. Some of the Site's existing utilities will remain as they currently exist, while the majority of the Site's utilities are proposed to be reconstructed or otherwise rehabilitated. Generally, stormwater systems have been sited to avoid conflict with critical utility infrastructure, both existing that will remain or new that will serve the proposed structures.

3.2.4 Criteria for Determining Maximum Extent Practicable

Section 8.4 of the Watertown Stormwater Management and Erosion Control Ordinance establishes Criteria for complying with the retention standard to the

Maximum Extent Practicable for all storms up to the 100-year, 24-hour storm event.

Factors Affecting Retention Potential

Factors affecting the Site's retention potential, which preclude the ability to fully meet the retention standard, have been identified in Section 3.2.3 of this report. These factors include groundwater elevations, location of existing and proposed utilities and other site infrastructure, historical site contamination, and environmental use restrictions.

This criterion is met.

Stormwater Runoff Reduction Measures

The Site has been designed to minimize impervious surfaces. The proposed design reduces impervious area on Site by approximately 2% (4.46 acres existing vs. 4.37 acres proposed). In addition to the proposed pocket park south of the proposed West Garage, the Site design includes:

- Permeable pavers
- Partial green roof for Building 2
- Rainwater cisterns
- Stormwater detention swales
- Subsurface detention systems
- Water Quality Structures

This criterion is met.

Disconnection of Roof Runoff

Roof runoff from proposed Building 2, the northern half of the proposed West Garage, and the southern half of existing Building 39 will be intercepted and directed to the on-site subsurface detention systems. The southern half of the proposed West Garage will be directed to two rainwater cisterns. Rainwater cistern overflow will then be transferred to an on-site subsurface detention system. The disconnection of roof runoff eliminates direct connections to the municipal storm system.

This criterion is met.

Disconnection of Pavement Runoff

Paved areas on-site have been designed to be disconnected from direct discharge to the municipal storm system. Paved areas on-site will flow to on-site stormwater BMPs as part of the Site's proposed stormwater network. Where

possible, paved areas are designed to flow over pervious landscape areas prior to entering the on-site stormwater BMPs. Additionally, the proposed Site design will reduce the amount of non-roof impervious areas by 10% via the construction of Building 2 on an existing parking area. The proposed Site design will reduce total impervious area by 2%. No new direct connections to the municipal storm system are proposed.

This criterion is met.

LID Techniques

LID techniques have been incorporated into the proposed stormwater system design for the Site. These techniques include permeable pavers, a partial green roof, rainwater cisterns, stormwater detention swales, water quality structures, and subsurface detention systems.

This criterion is met.

Peak Rate and Volume Reduction

The Site has been designed to reduce peak stormwater runoff rates discharging from the site. As shown in *Tables 2.4 and 2.5*, peak stormwater runoff rates discharging from the Site have been reduced for all storms up to and including the 100-year, 24-hour storm event. Due to the Site-specific conditions outlined in Section 3.2.3 of this report, utilizing stormwater recharge to reduce the volume of stormwater runoff is not practicable.

This criterion is met.

TSS Removal

The Site has been designed to achieve a minimum TSS removal of 80% in accordance with the Massachusetts Stormwater Policy. Refer to Section 2.4 of this report for more information.

This criterion is met.

MA Stormwater Management Policy

As documented in Section 2 of this report, all other standards of the Massachusetts Stormwater Policy have been met.

This criterion is met.

3.2.5 Documentation of Maximum Extent Practicable

- Site-specific conditions affecting the ability to fully retain stormwater are described in Section 3.2.3 of this report.
- The proposed design includes a wide range of stormwater BMPs and LID techniques, which were all considered for use on-site where appropriate to achieve the overall goals and objectives of the Site design.

4.0 Erosion and Sediment Control Plan

See the full Stormwater Report for the Erosion and Sediment Control Plan developed for the Site.

5.0 Operation and Maintenance Plan

See the full Stormwater Report for the Operation and Maintenance Plan developed for the Site.



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Consultants

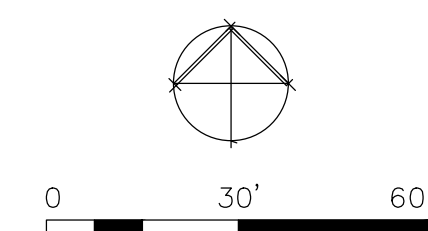
Legend

Notes



Permit-Seal

FIG. 3

[illegible]

Client/Project
Athena Arsenal, LLC
THE ARSENAL ON THE CHARLES
WEST GARAGE, BUILDING 2, AND
SITE IMPROVEMENTS
Watertown, MA 02472

Title

ACTIVITY & USE LIMITATIONS

Project No.	Scale
210801385	AS NOTED

Drawing No.